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# Drainage Engineering (BTAI3103)

## Module 1 Basics of Agricultural Drainage (Lecture-02: Land drainage system)

**DEPARTMENT OF AGRICULTURAL ENGINEERING, SoABE  
CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT  
PARALAKHEMUNDI, ODISHA**



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# Source of Excess water

- ✓ Direct rainfall constitutes the major and most common source (humid climate)
- ✓ Snowmelt water during spring seasons (cold and moderate climates)
- ✓ Other sources of excess water are irrigation, seepage, runoff and flood water
- ✓ Intense, heavy storm (Semi arid climate)

## **Note:**

- ✓ The drainage load from rainfall not only depends on the amount of rainfall but also on the storage capacity of the soil and on the rate of evapotranspiration.



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# Drainage system

## Collection System

Which picks up the water from the land by the surface field ditches

Field drains & field lateral

## Disposal System

Which conveys the collected water to the outlet usually through the open channel

Sub-mains & main

## Outlet

Which control the exit of drain water

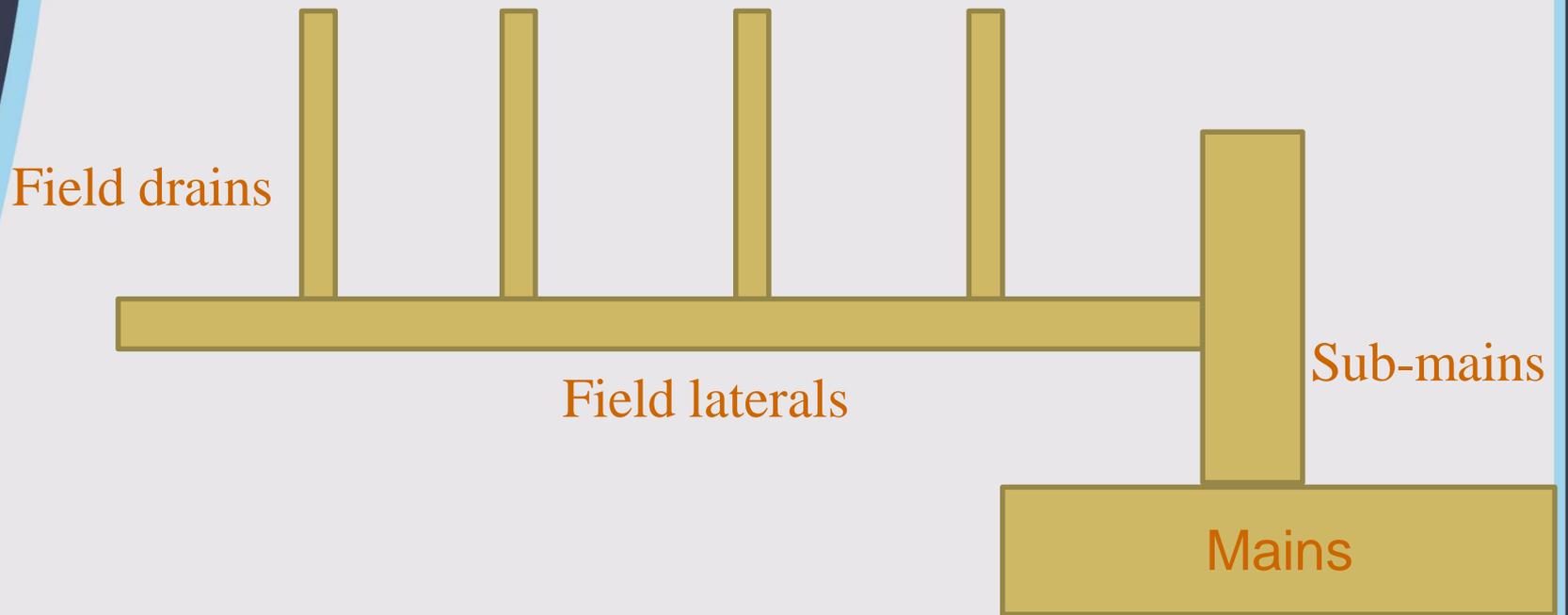
Outlet



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# Drainage system

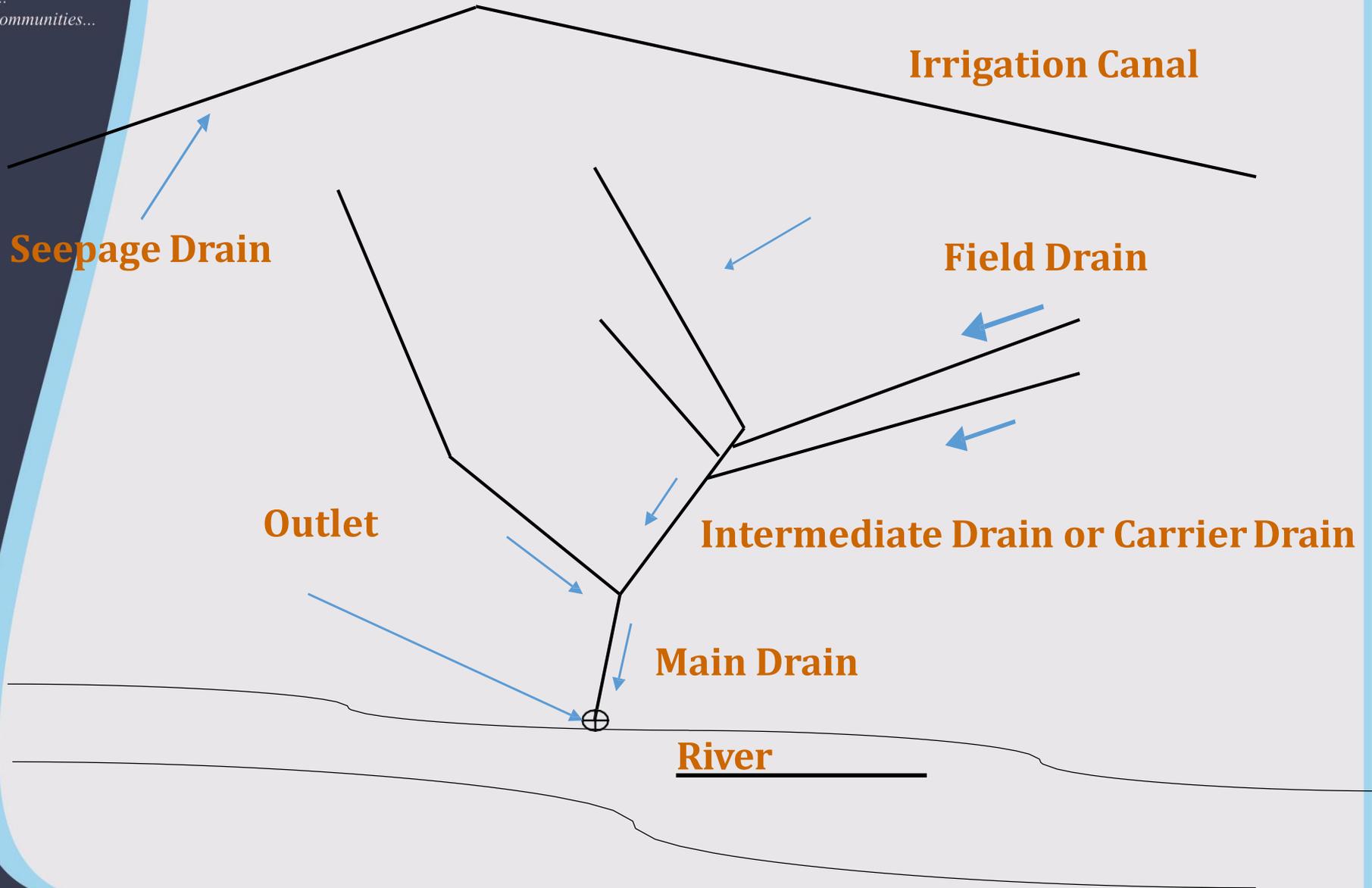




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# Drainage system





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# Types of Drainage System

Three most commonly used techniques for removing (draining) excess water are:

- ✓ Surface drainage
  - ✓ Subsurface drainage
  - ✓ Vertical drainage  
(tube well drainage)
- Conventional technique

## Non-Conventional technique

- ✓ Bio- Drainage

**Ex- Eucalyptus, Poplar etc.**



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# Surface Drainage

- ✓ Surface drainage can be defined as (ASAE, 1979):  
“Surface drainage is the removal of excess water from the soil surface in time to prevent damage to crops and to keep water from ponding on the soil surface.
- ✓ Surface drainage is a suitable technique where excess water from rainfall or surface irrigation cannot infiltrate into the soil and move through the soil to a drain, or cannot move freely over the soil surface to a natural/artificial drainage channel.
- ✓ Surface drainage problems occur in flat or nearly flat areas, in the areas having uneven land surfaces with depressions or ridges preventing natural runoff, and in the areas where there is no outlet.



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# Subsurface Drainage

- ✓ Subsurface drainage is defined as ‘the removal of excess soil water in time to prevent damage to crops because of a high water table’.
- ✓ Subsurface drainage problems occur in the areas having shallow water table (e.g., canal commands).
- ✓ Subsurface field drains can be either open ditches or pipe drains, but nowadays they are mostly pipe drains. Pipe drains are installed underground at depths normally ranging from 1 to 3 m (Bos and Boers, 1994). Excess groundwater enters the perforated field drains and flows by gravity to outlet



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# Vertical Drainage

- ✓ It is accomplished using shallow or deep tube wells; sometimes open wells are also used.
- ✓ Vertical drainage is when excess accumulated surface runoff water is to be disposed by recharging it into deeper aquifers through a tube well (i.e., recharge well), wherein the flow through the recharge well is vertically downward.



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# Design Considerations for Land Drainage

Water balance of the area to be drained is the most accurate tool to calculate the volume of water required to be drained (Bos and Boers, 1994).

- ✓ A number of field investigations should be undertaken which would result in adequate hydrogeological, and topographic maps (Bos and Boers, 1994), among other information.
- ✓ The precipitation and relevant evapotranspiration data from the area under investigation should be analyzed



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**Drainage Co-efficient:** It is defined as the depth of water to be removed within 24 hours over the area under consideration. This parameter helps in designing the rate of flow and the size of the drainage channel or pipe.

### Problem: 1

A watershed of 1500 hectares is discharging through a drain at an average rate of  $2.5 \text{ m}^3/\text{s}$ . Calculate the drainage coefficient. If the drainage coefficient is 3 cm. What would be discharge through the drain.



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